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ABSTRACT

A computer-assisted instructional (CAI) program is being used at the University of Michigan School of Dentistry to aid in the teaching of oral diagnosis to dental students. The program is designed to simulate a real life situation--i.e., the diagnosis of patient illness-which would not be otherwise available to the student and to demonstrate to the dental student the need for correlating a thorough case history with a clinical examination and laboratory tests. The computer program is branching and non-linear, with a small specialized dictionary. It provides the student with a series of 15 case histories and a list of laboratory studies from which to choose. For each case, the student receives and verifies the results of the tests he specifies and then makes a diagnosis. Field test results show that the program meets student needs, saves them time, and that they prefer the CAI mode. At the suggestion of the students, plans are being made to expand the program to include a greater number and variety of cases and to offer more difficult challenges. (Author/LB)

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COMPUTER AIDED INSTRUCTION AND PROBLEM SOLVING IN THE TEACHING OF ORAL DIAGNOSIS*

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Introduction

One of the areas that computer-aided-instruction has been shown to be effective is in the area of simulation of real life situations. These situations generally include cases that would be too expensive to provide actual experience for the student, cases in which the time allotted to fully assemble all the data and complete tests is much too short, or those situations where the experience cannot be provided to the student because it is not available when needed. These conditions are frequently the situation in the field of dentistry. Time is at a premium during the educational process of the dental student. He is in class or laboratory generally eight hours, five days a week. Thus, the process of scheduling educational experiences, the expense of providing them and the time span in which they are allotted can be difficult to arrange. As a result, many diverse real life situations cannot be experienced currently by dental students, because patients with the appropriate illnesses are not available at the time the student needs the experience. This paper describes one effort to develop an effective computer program to supply these experiences.

Review of Literature

Computer simulation in the teaching of Oral Diagnosis is limited to only a half dozen courses[1,2,3] and these are taught in but a handful of schools. Medical schools are somewhat ahead of dental schools in the use of simulation of medical diagnosis[3], but so far as dentistry is concerned, there is no widespread use of this technique in the critical area of dental education: oral diagnosis. By combining lectures and seminars with the computer, and by limiting the material to a limited area of knowledge, a realistic situation, relating to a patient, can be presented to the student.

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IR 000 389

CAI Technique

About two years ago, we began work on a CAI program designed to provide supplemental experience to the dental students in this particular area. We soon discovered that the field of oral diagnosis encompassed a fairly wide area with many inherent problems. Among these problems were those connected with patient history taking, with its many ramifications, and the corresponding computer problems of student response processing. We therefore narrowed the field and concentrated initially on the laboratory studies and diagnosis portion, saving the other parts for future developments.

The objectives of the program were (1) to demonstrate to the student the need for obtaining a thorough case history, correlating the history with the clinical examination and the ordering of appropriate laboratory studies to provide adequate answers for a diagnosis and (2) to provide a realistic situation in which dental students could practice their newly acquired knowledge.

The program is organized with material selected from actual cases in the files of the oral diagnosis department. The health questionnaires used with each case are exact copies of those filled out by the patient. Thus, actual case histories and participation by the student form a realistic situation for the student. The questionnaires are handouts to the student to jot down pertinent details and, at the same time, give the student practice in interpreting signs and symptoms from a lay terminology standpoint (which can be most interesting and frustrating). To complete the information given initially to the student, 2x2 color slides of the pertinent clinical areas of interest are furnished, plus the chief complaint and the present illness. These latter two pieces of information are findings a student would get by taking a patient history and initially talking with the patient.

Example 1 shows a portion of one of the cases. The cases, themselves, are structured in an easy-to-difficult scale, to build up the confidence in the weaker student and, at the same time, offer a challenge to the more advanced student. After assimilating the initial information, the student is given a list of laboratory studies to choose from. This list of studies is kept constant throughout the program, but is diversified enough to cover all cases. The object is to leave enough avenues of inquiry open to the student and still keep the

list a reasonable length. The lists of possible laboratory studies and diagnoses are presented by the computer in each case. This is done on purpose. We have found, from other programs, that students become exceedingly frustrated by continuously having to sort through sheets of acceptable answers.

For each laboratory study selected, which is appropriate to the case, complete test results are given in a form compatable with an actual laboratory report, along with the significance of its results, in terms of the patient history. The student must then verify that these results are either normal or abnormal. If he is correct in his answer, the computer reinforces the decision with confirming evidence. In the beginning cases, the type of information which can be gleaned from a particular test is detailed and its significance is explainca.

If the student claims that the test values are normal and they are not, both patient values and normal values are displayed so that the student may now compare the two sets. The program thus forces the student to learn these values because he knows that the test is used in later cases. In any case, he is not allowed to go further without a verification of the test results or a comparison of the test results with normal values, plus an explanation of the importance of the test.

If the test selected is unsuited to the particular case, the program explains why the test is not pertinent and provides additional information as a hint to guide the student. The hint usually consists of a summary of the pertinent details, especially in the beginning cases. In some of the later cases, the student should know better and the program reminds him.

When the student feels he has enough information to make a diagnosis, he signals the computer that he is ready to make a diagnosis. The computer checks to see if he has selected all the appropraite tests so that he has sufficient information to make a diagnosis. If all the pertinent tests have not been selected, the student is locked out of making a diagnosis and is informed that he has not selected all the relevant studies. When all the proper studies have been ordered and the necessary information gathered, the student is asked to make the final diagnosis. If the student's answer is not correct, all the information is summarized and deductions are made. The student is again asked to make a diagnosis. When the case is correctly identified, a complete summary is presented.

The case summary presents all the pertinent details and their significance to the case. Also, any extraneous information that was presented in the case is explained. The student is told that these details often come from the way the patient filled out the health questionnaire, and really have nothing to do with the case. A brief description, of what actually transpired for the patient and the results obtained, is given. The program limits itself to laboratory studies and diagnoses and refrains from involvement with treatment planning and the treatment itself, leaving these to future programs.

The current program is a branching, non-linear program with a small specialized dictionary that responds to a limited number of non-ambiguous requests and keywords. The student is allowed to backtrack to refresh his memory on the chief complaint and oral examination. Current efforts are in the direction of making the program completely table driven and expanding the dictionary.

Results

A pilot study of approximately ten students was conducted on the original program which contained five cases. A course specific evaluation questionnaire, filled out by the students, provided a wealth of information for diagnosis of problems and provided a subjective evaluation of the program. The student evaluation form (see Figure 1) asked the students to determine (1) how well they felt the program was meeting their needs, (2) what their feelings were about CAI versus seminar methods and (3) to get general comments for improvements. The program was revised on the basis of the critique and run with 150 students, again with a course specific evaluation questionnaire. The results of the questionnaire are shown in Figure 2 and overwhelmingly show that the students prefer the CAI mode of presentation. The current version has been expanded three-fold and most of the student suggestions have been implemented.

The general comments of the students indicated that they wanted more cases, increased difficulty and greater variety. They also enjoyed going at their own pace, and there was no "fear of making a fool of oneself."

Clinically, the program has had a significant impact on lessening the teaching load. Previously, seminars and classes were given explaining the procedures. Students were then taken to the hospital and were given cases in

which they had to order laboratory studies and determine the diagnosis of the patients. The instructor at the hospital spent much of his time reeducating and reexplaining the procedures to the class. The students were not relating didactic studies to the real life situation.

Current observations by the clinical staff reveal that the amount of reemphasis time and the number of simple questions students ask in the clinic situations have dropped considerably. This has allowed more time for interpretation and synthesis of clinical material. The time spent on the computer program has given the students the intial contact and experience they need to intelligently order the appropriate laboratory tests. In monitoring the students requests for laboratory studies and the diagnosis given, clinic instructors hear the students say that their current case is often similar to those they had previously seen in the computer program.

Summary

By carefully choosing the subject area and limiting it in scope, we have provided a realistic learning experience for dental students. The computer simulation combined material from actual case histories, realistic patient health questionnaires and 2x2 slides of the relevant areas into a compact effective program. It has shifted the information passing mechanism from the instructors' shoulders to the computer. As a result, clinical instructors have more time to discuss the merits of the cases and work with the students.

Example 1

(The Chief Complaint is Given)

CASE #5: A 21 YEAR OLD CAUCASIAN MALE PRESENTS HIMSELF TO YOUR OFFICE FOR "GETTING MY WISDOM TEETH OUT. I HAVE BEEN CUTTING THIS TOOTH FOR THE LAST SIX MONTHS AND NOW IT IS ALL SWOLLEN AND SORE. MY ENTIRE LOWER JAW HURTS ON THAT SIDE AND I CAN'T EAT OR OPEN MY MOUTH."

NOW LOOK AT THE HEALTH QUESTIONNAIRE FOR CASE #5. PRESS THE "CARRIAGE RETURN" KEY WHEN READY. (The computer waits until the student signals he is ready and then presents the clinical examination).

THE CLINICAL EXAMINATION IS UNREMARKABLE EXCEPT FOR THE AREA OF THE CHIEF COMPLAINT. WE SEE #17 IS MESIALLY INCLINED WITH SOME OF THE CUSPS PROTRUDING THROUGH RED AND INFLAMMED GINGIVAL TISSUE. THE AREA IS TENDER AND SWOLLEN. #16 IS EXTRUDED AND IMPINGING UPON THE EDEMATOUS LOWER SOFT TISSUES. RADIOGRAPHS INDICATE A SOFT TISSUE PARTIAL IMPACTION OF #17 AND AN EXTRUDED, FUSED ROTTED #16. TREATMENT WOULD BE IRRIGATION OF THE PREICORONITIS AND EXTRACTION OF #16. AFTER THE INFLAMMATION HAS SUBSIDED THEN EXTRACTION OF #17. AS YOU TURN OFF YOUR OPERATORY LIGHT, YOU NOTICE SOMETHING ABOUT YOUR PATIENT"S EYES WHICH YOU DIDN"T SEE UNDER ARTIFICIAL LIGHT. IN THE NATURAL LIGHT YOU SEE A COLORATION OF THE SCLERA OF THE EYE. IN DIRECT SUNLIGHT YOU OBSERVE A GREEISH-YELLOW TINT. (LOOK CAREFULLY AT SLIDES 12 AND 13. YOU SEE THE PATIENT IN THE FIRST SLIDE AND THE SECOND SLIDE SHOWS THE PATIENT AND YOUR BROWN EYED PARTNER). THIS ALERTS YOU TO A SYSTEMIC PROBLEM WHICH COULD HAVE A MAJOR BEARING ON YOUR TREATMENT PLAN AND PROCEDURES. NOW YOU WANT A/SOME LABORATORY STUDIES. CHOOSE THE IMPORTANT

STUDIES. (TYPE NONE IF THERE ARE NONE OR IF YOU ARE FINISHED.)

(1) V.D.R.L.

(2) C.B.C.

(3) COAGULATION SERIES

(4) CULTURE

(5) EXFOLIATIVE CYTOLOGY

(6) SIMPLE URINALYSIS

(If the student selects V.D.R.L., Test #1, the response is:)

THERE IS NO NEED TO CHOOSE THIS TEST. PLEASE ORDER ONLY TESTS WHICH RELATE DIRECTLY TO THE PROBLEM. OTHERWISE IT WILL COST THE PATIENT MONEY AND THE LABORATORY TIME WHICH COULD BE SPENT ON PERTINENT TESTS.

(If the student selects C.B.C., Test #2, the response is:)

THIS IS A GOOD TEST BUT DO YOU KNOW WHY YOU ARE ORDERING IT? LET ME GIVE YOU THE RESULTS AND THEN WE CAN MULL THEM AROUND IN OUR MINDS TOGETHER.

WHITE BLOOD CELLS	15,000/CU.MM.
RED BLOOD CELLS	5.04×10^6/CU.MM.
HEMATOCRIT-PLASMA IS MARKEDLY ICTERIC	40%
HEMOGLOBIN	16 GM/100 CC.
M.C.V. (MEAN CORPUSCULAR VOLUME)	88

(etc.)

(If the student types "none" without selecting the pertinent tests (2 and 3) the response is:)

YOU HAVE NOT SELECTED ALL THE PERTINENT TESTS.

FIGURE 1

I. Take the role of a student offering a critique of the present program. What single recommendation would you make to the faculty author that would be most positively contribute to the effectiveness and/or interest of the program.

II. Taken as a whole, did the unit serve a useful instructional function?

III. Did you find the unit intellectually stimulating and interesting?

IV. Seminars have been used as an alternative to the present method to serve the same instructional purposes. Which method do you personally prefer?

V. How effectively was your time utilized in terms of the amount learned in the time expended?

The next two items are statements taken from the course objectives. The student was asked to subjectively evaluate how well he thought these objectives were met.

VI. Given data from the health questionnaire and clinical findings, state what laboratory studies are indicated.

VII. Given results of laboratory studies and assuming other data from the health questionnaire and clinical findings, make a diagnosis.

VIII. Was any material presented which you think might better be offered by another method? If so, please identify and explain.

IX. Do you think that other materials or techniques (in the sense of kinds of questions, approaches) could have been incorporated into the present program?

FIGURE II

		n = 79
I.	Response	77% (61)
	NA	22% (18)
II.	Decidedly yes	60% (48)
	Yes	39% (31)
	Uncertain	-
	No	-
	Decidedly no	-
	NA	-
III.	Decidedly yes	50% (40)
	Yes	46% (37)
	Uncertain	02% (02)
	No	-
	Decidedly no	-
	NA	-
IV	Definitely CAI program	22% (18)
	CAI program	32% (26)
	Uncertain	20% (16)
	Seminar	11% (09)
	Definitely seminar	03% (03)
	NA	08% (07)
V.	Very effectively	30% (24)
	Effectively	54% (43)
	Uncertain	12% (10)
	Ineffectively	-
	Very ineffectively	-
	NA	02% (02)
VI.	Definitely effective	35% (20)
	Effective	59% (47)
	Uncertain	07% (06)
	Ineffective	01% (01)
	Definitely ineffective	-
	NA	06% (05)
VII.	Defintiely effective	27% (22)
	Effective	53% (42)
	Uncertain	12% (10)
	Ineffective	01% (01)
	Definitely ineffective	-
	NA	05% (04)
VIII.	Yes	10% (08)
	Uncertain	20% (16)
	No	63% (50)
	NA	06% (05)
IX.	Yes	39% (31)
	Uncertain	30% (24)
	No	20% (16)
	NA	10% (08)

NA signifies either (1) no response, (2) comments only or (3) two or more circled items.

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